

Opportunities and Challenges for Alternative Fuels

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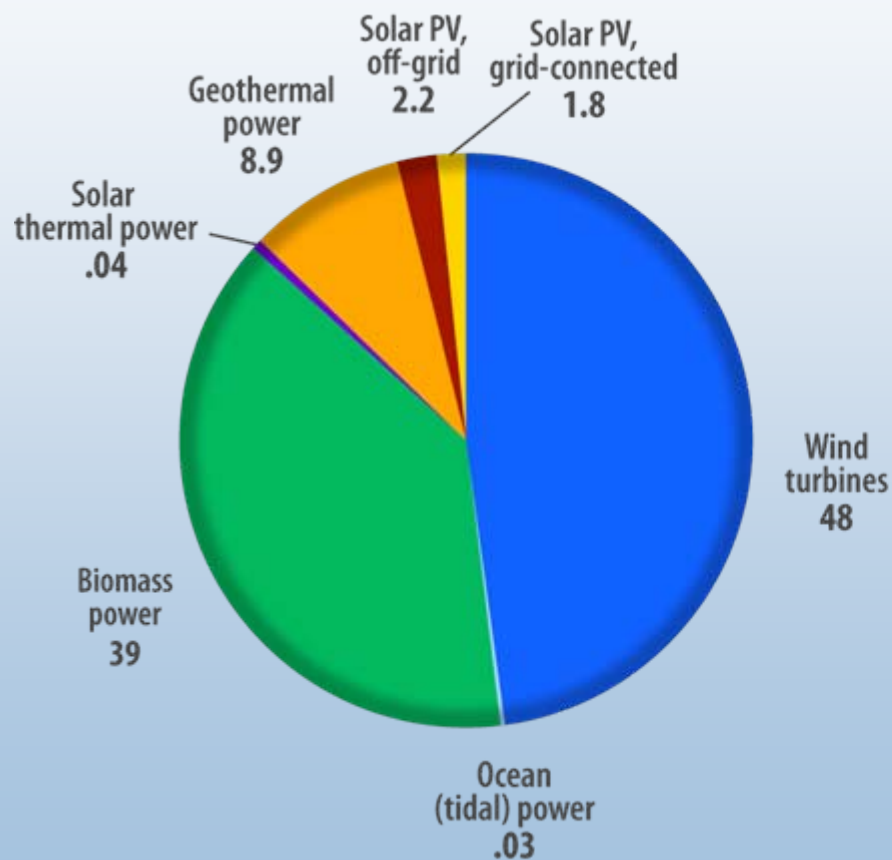
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Renewable Energy Indicators

As of Year End 2004

Power Generation

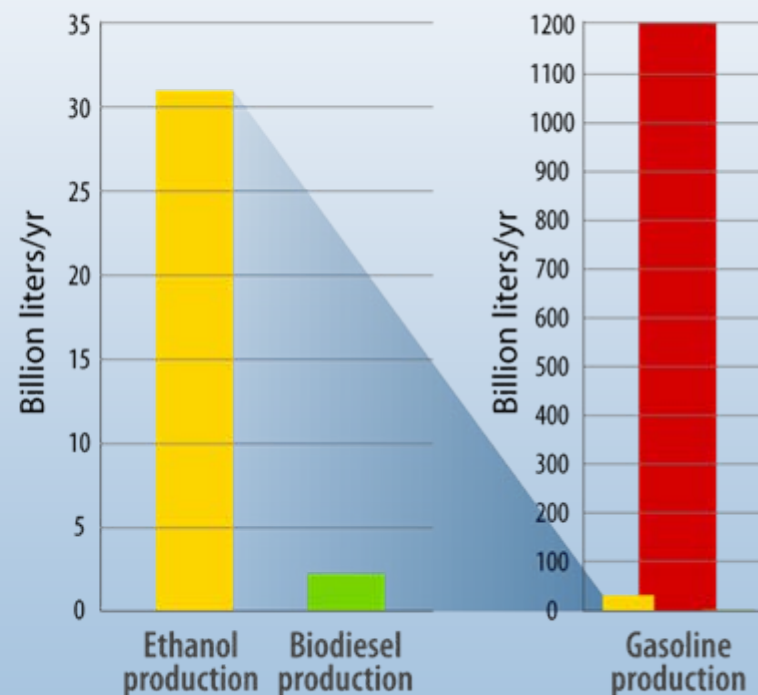
Existing Capacity* – GW



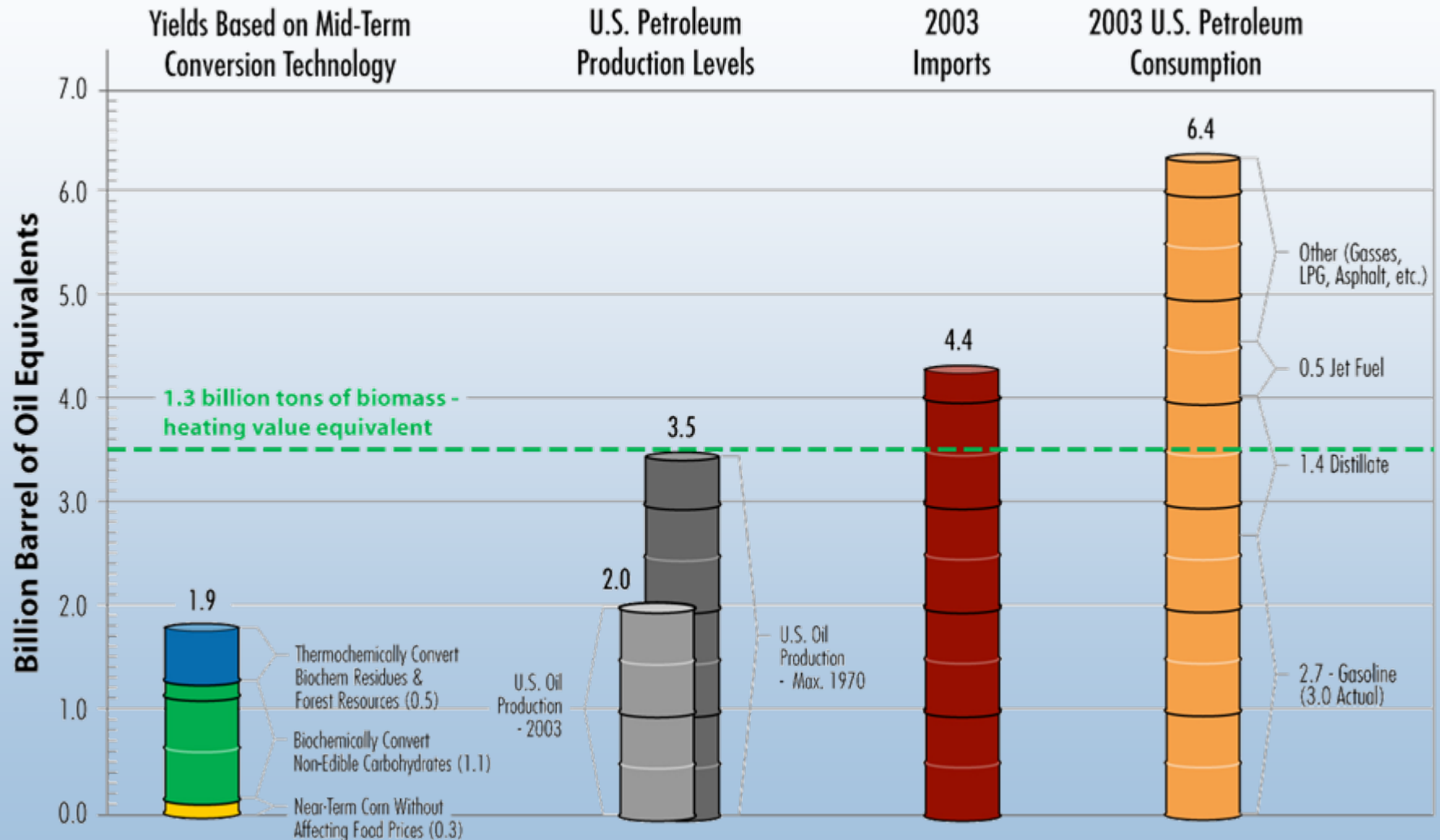
*Does not include hydropower

Transport Fuels

Billion liters/year



Significance of the 1.3 Billion Ton Biomass Scenario



Based on ORNL & USDA Resource Assessment Study by Perlach et.al. (April 2005)
http://www.eere.energy.gov/biomass/pdfs/final_billionton_vision_report2.pdf

Biofuels

Biofuels status

- Biodiesel – 75 million gallons (2005)
- Corn ethanol
 - 81 commercial plants
 - 3.9 billion gallons (2005)
 - Today's cost ~\$1.35/gallon of gasoline equivalent (gge)
- Cellulosic ethanol
 - Projected commercial cost ~\$3.00/gge



Potential

- 2012 goal – cellulosic ethanol ~\$1.42/gge
- 2030 goal – all ethanol = 30% of transportation fuels

NREL Research Thrusts

- The Biorefinery
- Solutions to under-utilized waste residues
- Energy crops

Building the Supply Chain



**Biomass
Feedstock
Supply**



**Biomass
Feedstock
Transport**



**Biomass
Conversion
Technology**



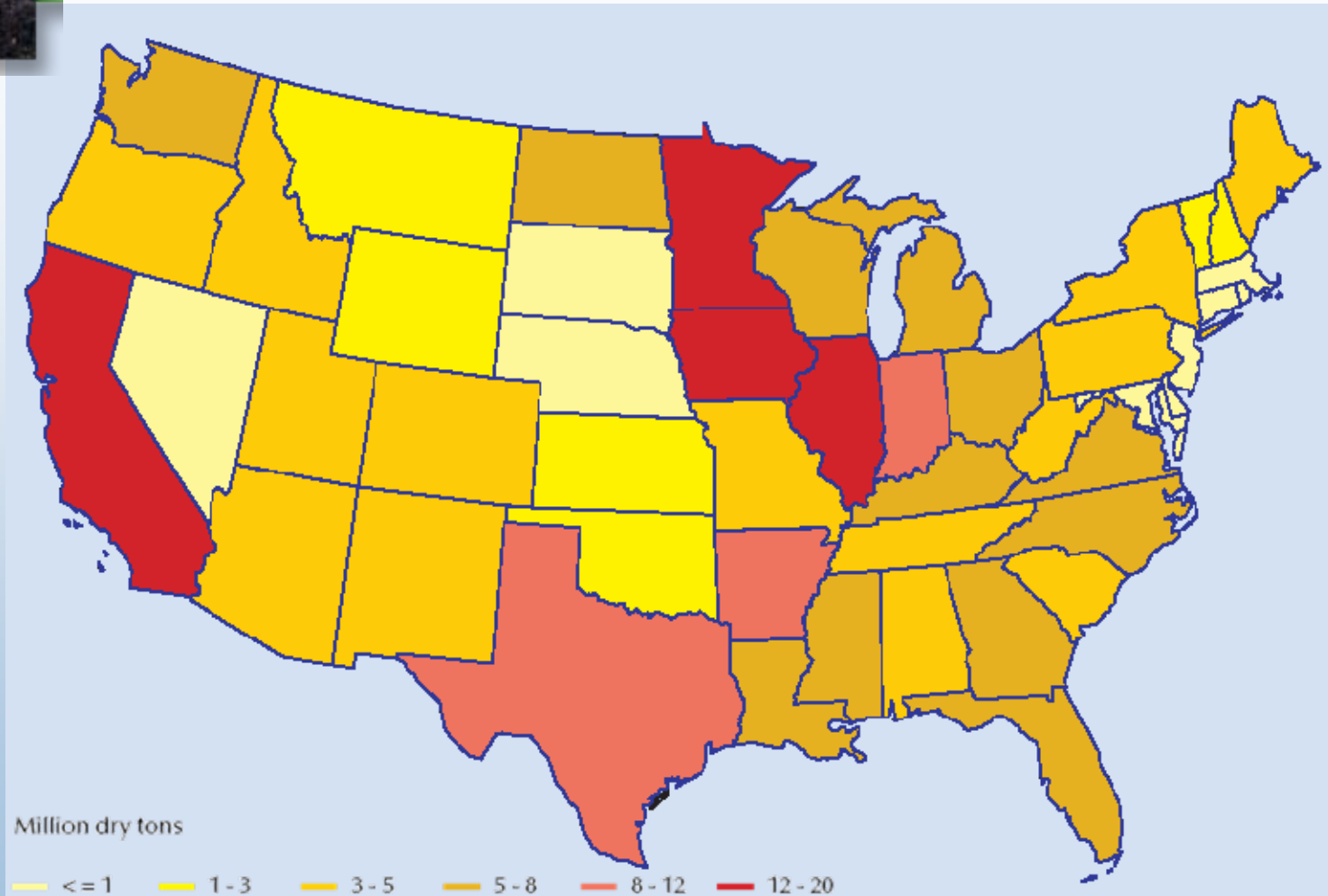
**Markets:
Fuels & Vehicles**





Biomass Feedstock Supply

Renewable Waste Resources

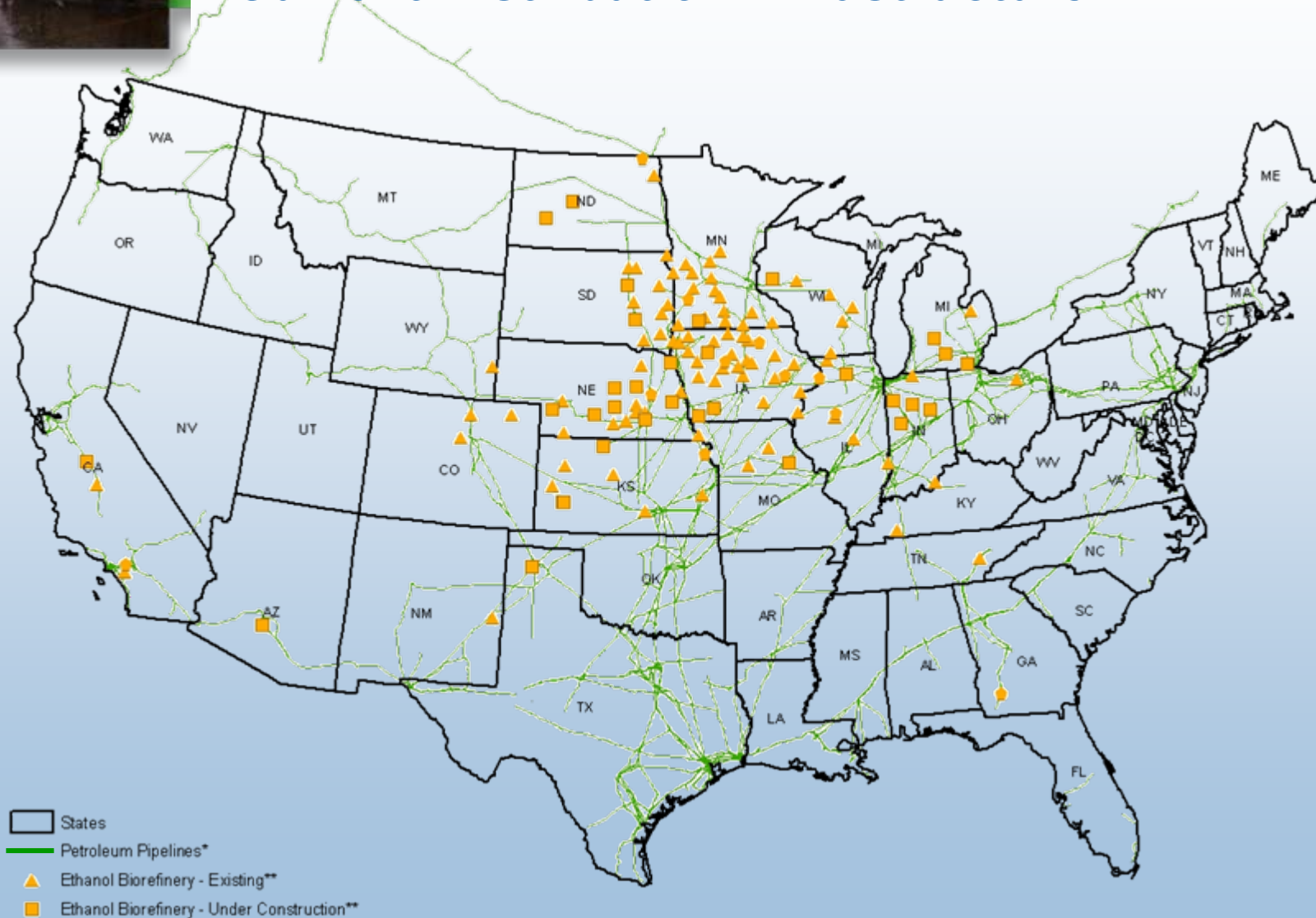


Source: National Commission on Energy Policy, *Ending the Energy Stalemate*, December 2004



Biomass Feedstock Transport

Current Distribution Infrastructure





Biomass Feedstock Transport

Ethanol Distribution Infrastructure Hurdles

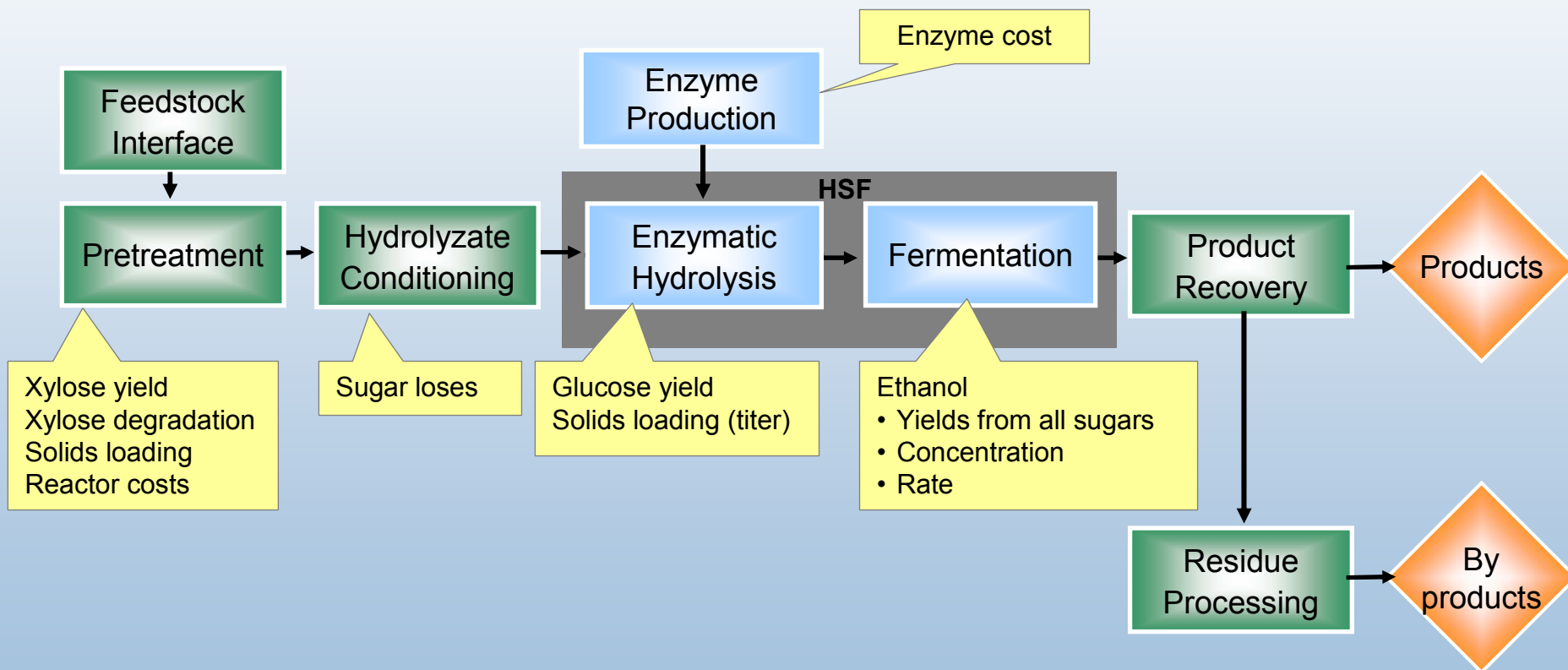
- Estimate that E85 pumps will be required in 50% of U.S. service stations
 - Public policy support may be necessary to encourage investment
- E10 and E85 may enter U.S. pipeline system
 - E10 may move through product pipelines if they are modified to trap water, sediment and to keep ethanol from other products (diesel)
 - E85 dedicated pipelines will be created to connect large producing centers to large use centers
- E85 pumps may require new or modified underground tanks at retail outlets





Biomass Conversion Technology

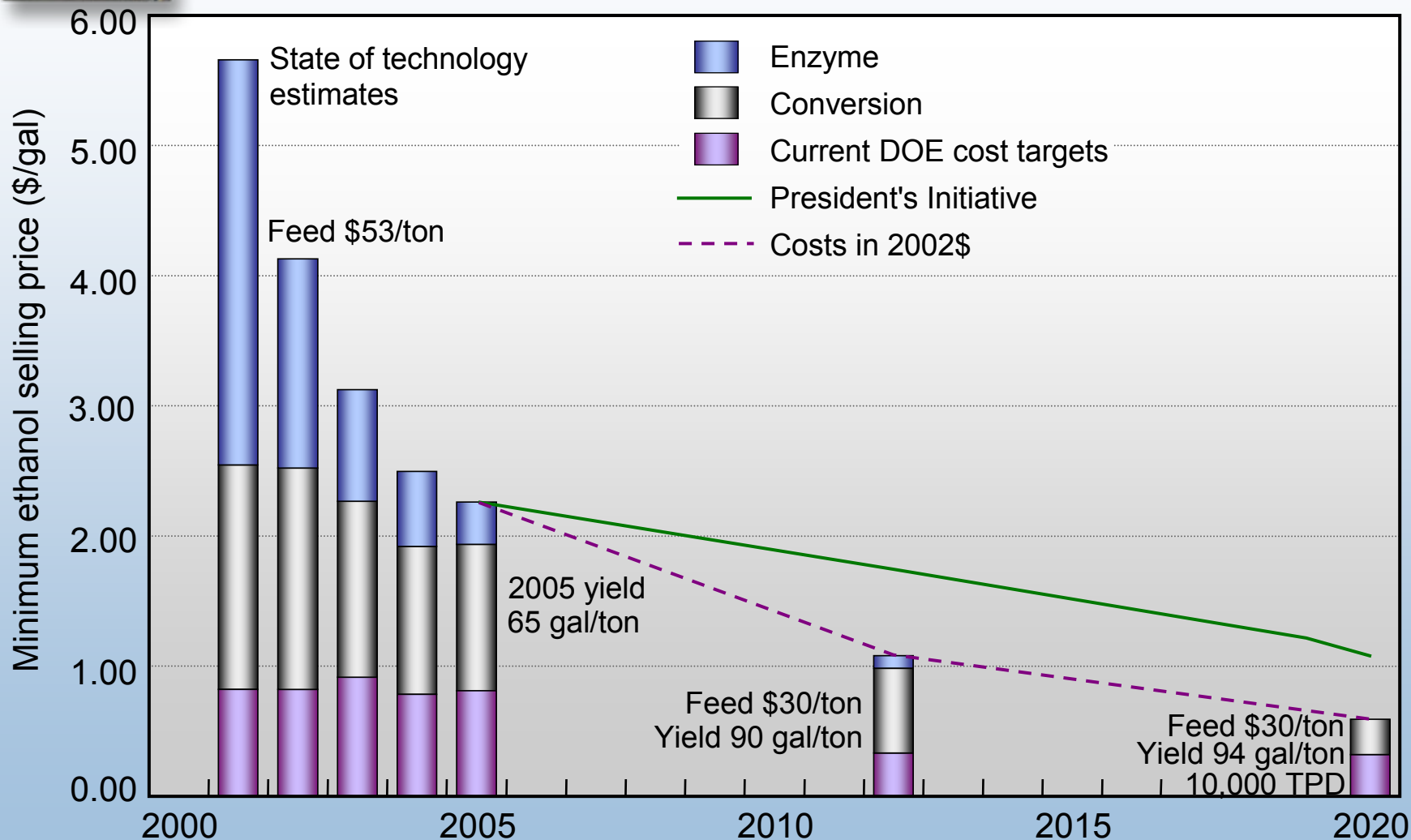
Biochemical Conversion Barrier Areas





Biomass Conversion Technology

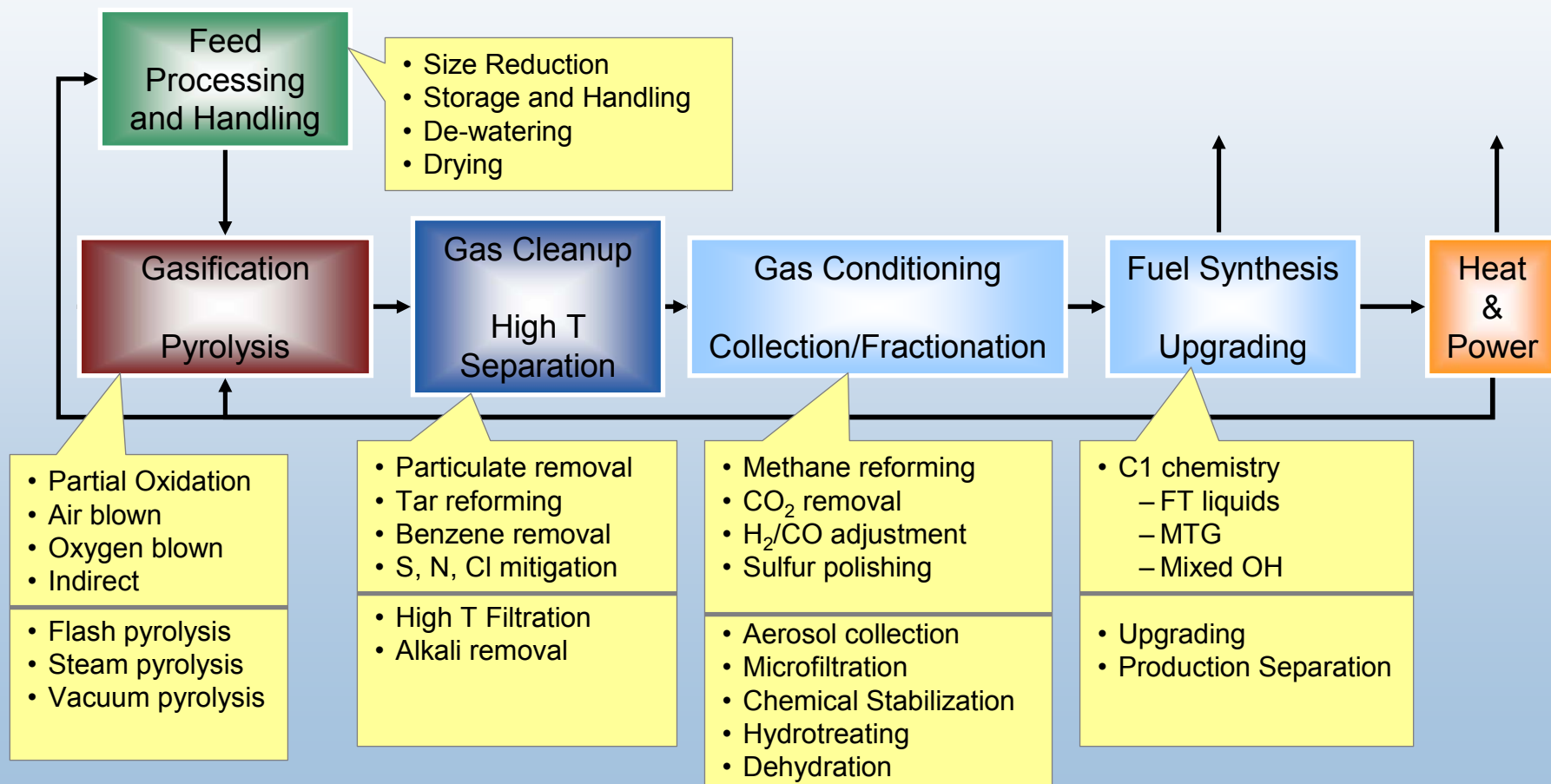
Reducing the Cost of Ethanol from Stover





Biomass Conversion Technology

Thermochemical Conversion Barrier Areas





Markets: Fuels & Vehicles

U.S. Transportation

	Autos	Light Trucks	Heavy Trucks	Airplanes
Share of transport fuel consumption	39%	28%	24%	9%
Fleet size – Millions	130	80	7	0.0085
New – Millions/year	8.5	8.5	0.5	Small
Median life – Years	17	16	28	22

Biggest, fastest savings



Markets: Fuels & Vehicles

Vehicle Needs

- Target to have all new light-duty vehicles being E85-compatible FFVs by 2020
 - This is a significant public policy opportunity
- May also encourage E85+ optimized FFVs to appear on large scale to help drive ethanol transition
- Next generation – Flex Fuel, Plug-in Hybrid Vehicles



30 x 30 Target

Replace 30% of 2004 motor gasoline demand with ethanol by 2030 – 60 billion gallons

Technologies

Reducing
Risk

Capital
Mobilization



Policies

Markets

The U.S. Department of Energy's National Renewable Energy Laboratory

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Golden, Colorado